

A Normalisation Example



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Based on work by Robert Timmer-Arends

Take the following table.

StudentID is the primary key.

StudentID	StudentName	Address	HouseName	HouseColor	Subject	SubjectCost	Grade
19594332X	Mary Watson	10 Charles Street	Bob	Red	English	\$50	B
					Maths	\$50	A
					Info Tech	\$100	B-

Is it 1NF?

No. There are repeating groups (subject, subjectcost, grade)

StudentID	StudentName	Address	HouseName	HouseColor	Subject	SubjectCost	Grade
19594332X	Mary Watson	10 Charles Street	Bob	Red	English	\$50	B
					Maths	\$50	A
					Info Tech	\$100	B-

How can you make it 1NF?

Create new rows so each cell contains only one value

StudentID	StudentName	Address	HouseName	HouseColor	Subject	SubjectCost	Grade
19594332X	Mary Watson	10 Charles Street	Bob	Red	English	\$50	B
					Maths	\$50	A
					Info Tech	\$100	B-



StudentID	StudentName	Address	HouseName	HouseColor	Subject	SubjectCost	Grade
19594332X	Mary Watson	10 Charles Street	Bob	Red	English	\$50	B
19594332X	Mary Watson	10 Charles Street	Bob	Red	Maths	\$50	A
19594332X	Mary Watson	10 Charles Street	Bob	Red	Info Tech	\$100	B-

But now look – is the *studentID* primary key still valid?

No – the studentID no longer uniquely identifies each row

StudentID	StudentName	Address	HouseName	HouseColor	Subject	SubjectCost	Grade
19394332X	Marr Watson	10 Charles Street	Bob	Red	English	\$50	B
19394332X	Marr Watson	10 Charles Street	Bob	Red	Maths	\$50	A
19394332X	Marr Watson	10 Charles Street	Bob	Red	Info Tech	\$100	B+

You now need to declare *studentID* and *subject* together to uniquely identify each row.

So the new key is *StudentID* and *Subject*.

So. We now have 1NF.

StudentID	StudentName	Address	HouseName	HouseColor	Subject	SubjectCost	Grade
19394332X	Marr Watson	10 Charles Street	Bob	Red	English	\$50	B
19394332X	Marr Watson	10 Charles Street	Bob	Red	Maths	\$50	A
19394332X	Marr Watson	10 Charles Street	Bob	Red	Info Tech	\$100	B+

Is it 2NF?

Studentname and **address** are dependent on **studentID** (which is part of the key)
This is good.

StudentID	StudentName	Address	HouseName	HouseColor	Subject	SubjectCost	Grade
19394332X	Marr Watson	10 Charles Street	Bob	Red	English	\$50	B
19394332X	Marr Watson	10 Charles Street	Bob	Red	Maths	\$50	A
19394332X	Marr Watson	10 Charles Street	Bob	Red	Info Tech	\$100	B+

But they are **not** dependent on **Subject** (the *other* part of the key)

And 2NF requires...

StudentID	StudentName	Address	HouseName	HouseColor	Subject	SubjectCost	Grade
19394332X	Marr Watson	10 Charles Street	Bob	Red	English	\$50	B
19394332X	Marr Watson	10 Charles Street	Bob	Red	Maths	\$50	A
19394332X	Marr Watson	10 Charles Street	Bob	Red	Info Tech	\$100	B+

All non-key fields are dependent on the ENTIRE key (**studentID** + **subject**)

So it's not 2NF

StudentID	StudentName	Address	HouseName	HouseColor	Subject	SubjectCost	Grade
19594332X	Mary Watson	10 Charles Street	Bob	Red	English	\$50	B
19594333X	Mary Watson	10 Charles Street	Bob	Red	Maths	\$50	A
19594335X	Mary Watson	10 Charles Street	Bob	Red	Info Tech	\$100	B+

How can we fix it?

Make new tables

- Make a new table for each primary key field
- Give each new table its own primary key
- Move columns from the original table to the new table that matches their primary key...

Step 1

StudentID	StudentName	Address	HouseName	HouseColor	Subject	SubjectCost	Grade
19594332X	Mary Watson	10 Charles Street	Bob	Red	English	\$50	B
19594333X	Mary Watson	10 Charles Street	Bob	Red	Maths	\$50	A
19594335X	Mary Watson	10 Charles Street	Bob	Red	Info Tech	\$100	B+

STUDENT TABLE (key = StudentID)

Step 2

StudentID	StudentName	Address	HouseName	HouseColor	Subject	SubjectCost	Grade
19594332X	Mary Watson	10 Charles Street	Bob	Red	English	\$50	B
19594333X	Mary Watson	10 Charles Street	Bob	Red	Maths	\$50	A
19594335X	Mary Watson	10 Charles Street	Bob	Red	Info Tech	\$100	B+

STUDENT TABLE (key = StudentID)

StudentID	StudentName	Address	HouseName	HouseColor
19594332X	Mary Watson	10 Charles Street	Bob	Red

SUBJECTS TABLE (key = Subject)

Step 3

StudentID	StudentName	Address	HouseName	HouseColor	Subject	SubjectCost	Grade
19594332X	Mary Watson	10 Charles Street	Bob	Red	English	\$50	B
19594332X	Mary Watson	10 Charles Street	Bob	Red	Maths	\$50	A
19594332X	Mary Watson	10 Charles Street	Bob	Red	Info Tech	\$100	B+

STUDENT TABLE (key = StudentID)

StudentID	StudentName	Address	HouseName	HouseColor
19594332X	Mary Watson	10 Charles Street	Bob	Red

SUBJECTS TABLE (key = Subject)

Subject	SubjectCost
English	\$50
Maths	\$50
Info Tech	\$100

RESULTS TABLE (key = StudentID+Subject)

Step 3

StudentID	StudentName	Address	HouseName	HouseColor	Subject	SubjectCost	Grade
19594332X	Mary Watson	10 Charles Street	Bob	Red	English	\$50	B
19594332X	Mary Watson	10 Charles Street	Bob	Red	Maths	\$50	A
19594332X	Mary Watson	10 Charles Street	Bob	Red	Info Tech	\$100	B+

STUDENT TABLE (key = StudentID)

StudentID	StudentName	Address	HouseName	HouseColor
19594332X	Mary Watson	10 Charles Street	Bob	Red

SUBJECTS TABLE (key = Subject)

Subject	SubjectCost
English	\$50
Maths	\$50
Info Tech	\$100

RESULTS TABLE (key = StudentID+Subject)

StudentID	Subject	Grade
19594332X	English	B
19594332X	Maths	A
19594332X	Info Tech	B+

Step 4 - relationships

STUDENT TABLE (key = StudentID)

StudentID	StudentName	Address	HouseName	HouseColor
19594332X	Mary Watson	10 Charles Street	Bob	Red

SUBJECTS TABLE (key = Subject)

Subject	SubjectCost
English	\$50
Maths	\$50
Info Tech	\$100

RESULTS TABLE (key = StudentID+Subject)

StudentID	Subject	Grade
19594332X	English	B
19594332X	Maths	A
19594332X	Info Tech	B+

Step 4 - cardinality

STUDENT TABLE (key = StudentID)

StudentID	StudentName	Address	HouseName	HouseColor
19594332X	Mary Watson	10 Charles Street	Bob	Red

1 Each student can only appear ONCE in the student table

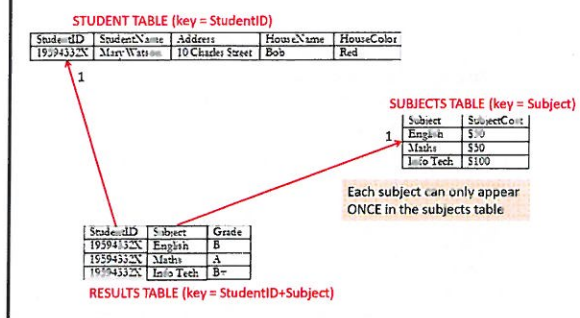
SUBJECTS TABLE (key = Subject)

Subject	SubjectCost
English	\$50
Maths	\$50
Info Tech	\$100

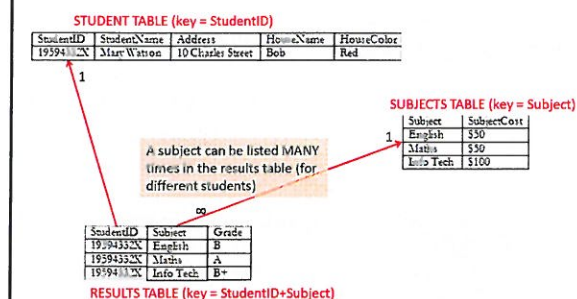
RESULTS TABLE (key = StudentID+Subject)

StudentID	Subject	Grade
19594332X	English	B
19594332X	Maths	A
19594332X	Info Tech	B+

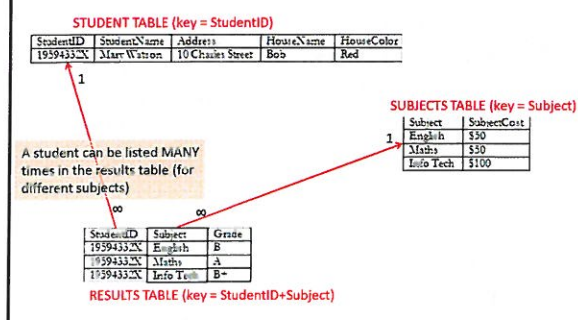
Step 4 - cardinality



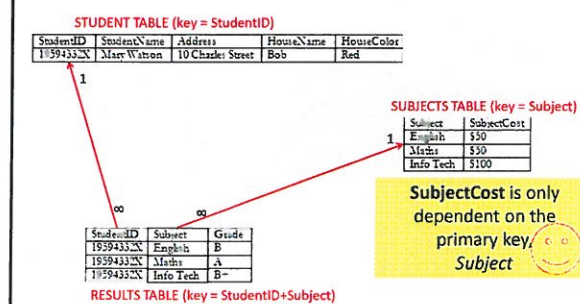
Step 4 - cardinality



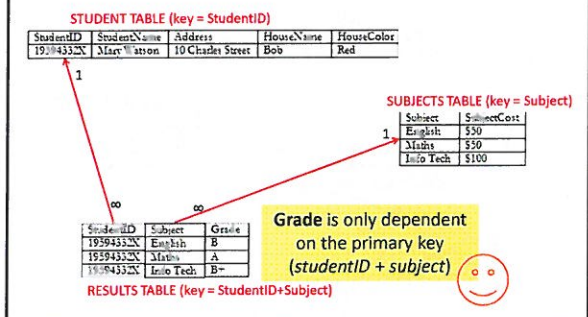
Step 4 - cardinality



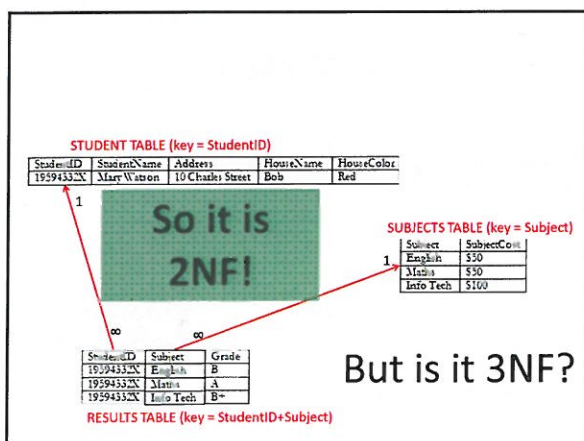
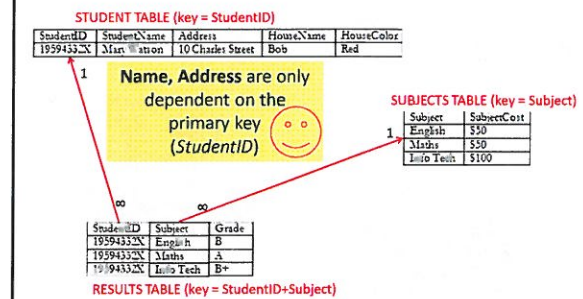
A 2NF check



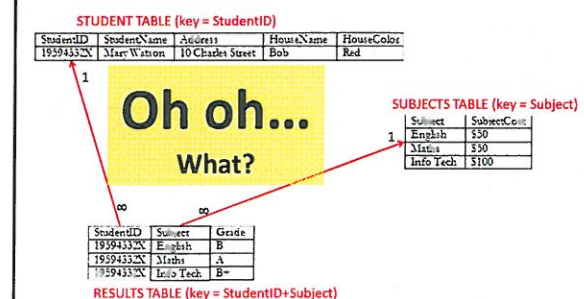
A 2NF check



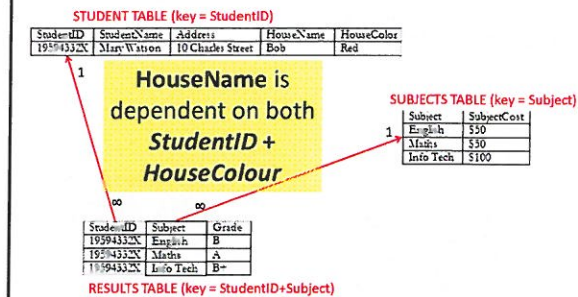
A 2NF check



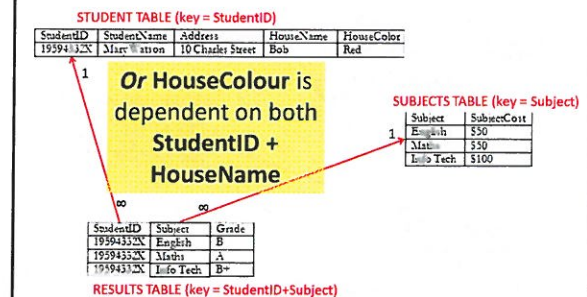
A 3NF check



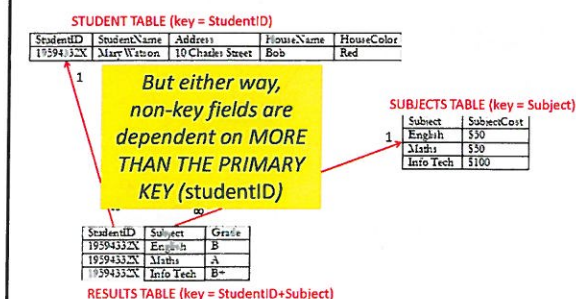
A 3NF check



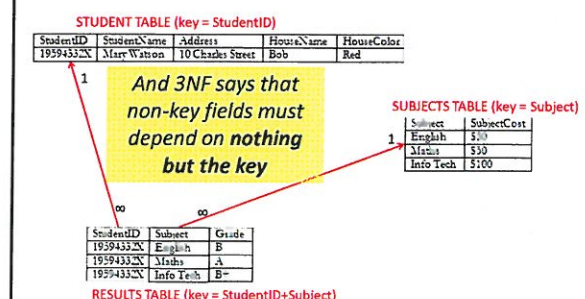
A 3NF check



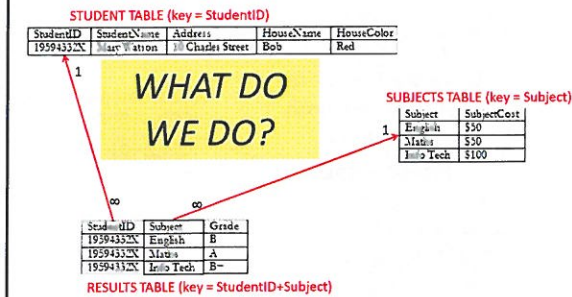
A 3NF check



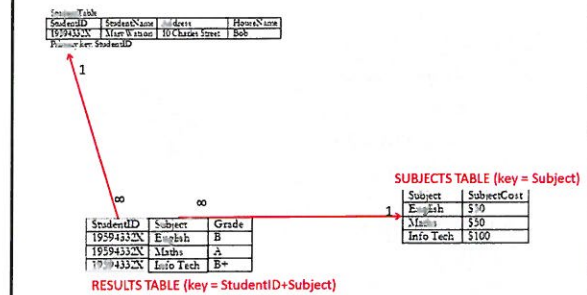
A 3NF check



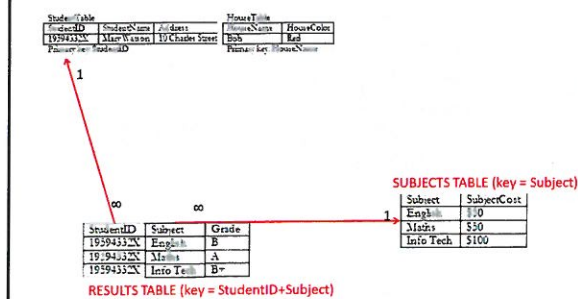
A 3NF check



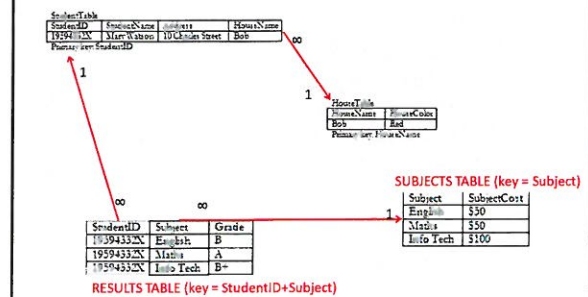
Again, carve off the offending fields



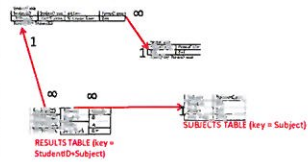
A 3NF fix



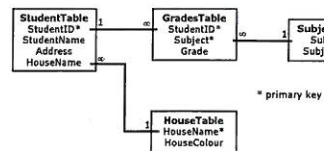
A 3NF fix



A 3NF win!



Or...



The Reveal

Before...

StudentID	StudentName	Address	HouseName	HouseColour	Subject	SubjectCost	Grade
19594323X	Mark Watson	15 Clarendon Street	Bob	Red	English	\$20	B
					Maths	\$10	A
					Info Tech	\$100	B+

After...

